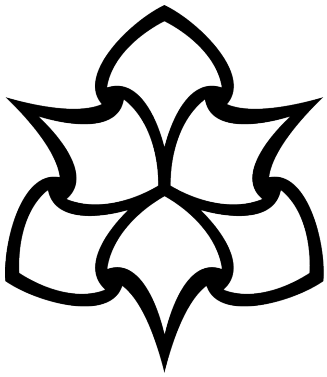

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Factors Affecting The Adoption of Intranets and Extranets by SMEs: A UK Study

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Abstract

The adoption of intranets and extranets involve major organisational innovation. Intranets alter the flows and content of internal communications, while extranets alter communications between the firm and its clients and suppliers. The paper identifies a number of potential factors that may affect adoption. These include internal and external business drivers, the role of the CEO/owner, firms' absorptive capacity, firm size amongst SMEs, and business activity. Neither the relative size nor the business activities of SMEs have been considered in previous studies.

Logit regressions are run on factors influencing the adoption of intranets and client extranet for a sample of 164 UK SMEs. The findings challenge two oft-stated views. First, that ICT adoption in SMEs depends on the CEO/owner being the ICT decision-maker. The findings clearly indicate that adoption is positively related to firm size. Larger sized SMEs firms have more complex organisational structures in which a specialist manager – typically holding the title 'IT Manager' – is the key decision-maker on ICT investments. Adoption depends on the quality and drive of these managers, not the CEO/owner. Second, the myth that services are technological laggards is clearly exposed. Knowledge intensive service firms, not manufacturing firms, are the champions of extranet technologies in this sample. In addition, both knowledge intensive service and manufacturing SMEs are key champions of intranet adoption. Expansion of national, not global, market share is the most important strategic objective identified in the study. The ability to integrate previously separate ICT systems is another important factor for intranet adopters. The results differ with respect to external customer and competitor pressure. These are found to be important in intranet adoption but not in extranet adoption. Only very weak support can be identified for the importance of absorptive capacity. A clear problem remains with regards to identifying a clear set of instruments with which to test for absorptive capacity.

Keywords: intranets, extranets, SMEs, knowledge intensive business services, innovation.

1. Introduction

Firms are currently investing in sophisticated e-business ICT systems, that exploit intranets, client extranets and supplier extranets, to re-integrate internal and external communications along the supply chain. This is the latest in a line of ICT adoptions. When exploited successfully, these investments improve firm competitiveness by either increasing the efficiency of internal/external communication and organisation, or by facilitating new/improved products and services. There exists a small but growing body of empirical research on the adoption of intranets, extranets and other e-business ICTs. Unfortunately, this research is overwhelmingly biased towards large, US firms with 250+ employees. Very few SME focused studies exist, and those which do are individual firm case studies.

There is a clear need for comprehensive studies of SMEs in European countries. To this end, the authors set up a UK SME tracking study in 2003[1]. The dataset was collected via an 8-page postal questionnaire and currently contains information on 164 services and manufacturing SMEs across the UK. The questionnaire collected data on a range of internet-based ICTs that include both e-commerce and e-business applications. This paper presents the first detailed statistical analysis of the dataset. In section 2, we consider a range of factors that may affect the adoption of e-business ICTs. This, in itself, is a non-trivial issue given the current dearth of large sample studies. Consequently, we consider empirical research on e-commerce and other older ICT adoptions. We also consider research conducted in a number of discipline areas - notably, the SME, innovation and information systems literatures. A set of ten internal/external business drivers is identified. In addition, past literature has highlighted the potential importance of the CEO/owner in IT decision-making, and the absorptive capacity of the firm on adoption.

The potential importance of firm size and business activity are also considered. The SME category is very broad. *Ex ante*, one would expect smaller sized SMEs to have different organisational structures to larger sized SMEs, different volumes of information communicated and stored, and so different ICT requirements.

[1] A general report, the 'SME-Internet Tracking Study Report', is available at <http://www.business.mmu.ac.uk/research/reports>.

Investment in ICTs is also likely to differ between business activities. Drawing on recent research in services, a distinction is made between knowledge intensive and non-knowledge intensive services. These are likely to have very different ICT requirements. Section 3 describes the dataset that has been used and presents some descriptive statistics. Using this dataset, the research hypotheses are tested by estimating two logit regressions; one on intranet adoption and the other on extranet adoption. The findings of the logit regressions are presented in section 4. Section 5 of the paper evaluates the findings, and considers the implications for future empirical research.

2. Factors affecting SME adoption of ICTs

Here we consider factors previously identified as being potential drivers of ICT adoption in SMEs (sections 2.1 to 2.3). As noted in section 1, very few studies of e-business ICTs adoption by SMEs exist. Hence, we will consider research on the adoption of e-commerce and older generations of ICT. Further, the discussion draws on a range of literatures that include information systems, technological innovation, and small firm/SME research. These have hitherto largely been treated as separate. In addition, we consider the influence of firm size and business activity (section 2.4) on different adoption patterns among SMEs. These have not been given due attention in previous research.

2.1 Key internal/external business drivers

As noted in section 1, there is dearth of large sample studies on e-business adoption in SMEs. In light of this, we consider a range of internal/external business drivers that have identified in the adoption of older generations of ICTs, and, in particular, e-commerce ICTs. Table 1 presents an overview of the drivers identified as important in the adoption of e-commerce systems. The table includes reference publications, and details of the sample size and maximum company size included in the studies. All of the studies are UK based and non-sector specific.

Table 1. External and internal drivers of adoption identified in e-commerce studies

External drivers	Sample size	Maximum company size	Author(s)
Customer pressure	298	<200	Quayle (2002)
	80	<250	Martin (2001)
Competitive pressure	678	<250	Daniel & Grimshaw (2002)
	80	<250	Martin (2001)
	2395	<250	DTI (2002)
Key suppliers	298	<200	Quayle (2002)
	678	<250	Daniel & Grimshaw (2002)
Internal drivers			
Perceived increasing importance of e-business	298	<200	Quayle (2002)
Increase national / global market share	678	<250	Daniel & Wilson (2002)
Costs reduction / increased efficiency.	80	<250	Martin (2001)
	2395	<250	DTI (2002)
Improve knowledge sharing.	678	<250	Daniel & Wilson (2002)
Improve communication with customers.	2395	<250	DTI (2002)
	678	<250	Daniel & Grimshaw (2002)
Enhanced customer service.	678	<250	Daniel & Grimshaw (2002)

First, it is worth noting that the number of statistical studies on the adoption of e-commerce systems is itself very low. Second, within the studies both micro businesses (1-10 employees) and SMEs (10-250 employees) are included. This is a common problem in SME research. There may be important differences between micro businesses and SMEs, as there may also be between small and larger sized firms within the SME category (see below).

A mixed and unclear picture emerges from UK studies of e-commerce adoption. Most noticeably, the key drivers that are identified differ significantly. The majority of e-commerce studies suggest that either customers or competitors provide the main impetus for adoption. Yet great inconsistencies exist within the findings. For example, Martin (2001) found both customer pressure and competitive pressure to be

statistically significant in his sample. By contrast, Quayle (2002) found customer pressure to be significant but competitive pressure not to be significant in his sample. The opposite was the case for Daniel and Grimshaw (2002) in their study. One finds that the main motivation(s) identified with a particular driver differ. For instance, amongst those studies that find customers to be the key driver, some report that direct customer pressure is the motivator while others report that the aim to improve communication or the quality of customer service is the motivator. Daniel and Wilson (2002) suggest that the downturn in the fortunes of many e-commerce ventures may have prompted the beginning of a shift from bandwagon-type adoption to strategy-driven adoption during the period of their study. Yet Quayle (2002), whose study was conducted in the same time period, could not identify a clear strategic approach to e-business in his sample.

Pressure from suppliers has also been identified in research on the adoption of older generations of ICTs, and has been postulated as a potentially important factor in theoretical research on e-commerce ICTs. Some studies do not include this within their studies. Of those that do, only Quayle (2002) identifies it as a key driver (ranked second, after customers). This brings us to a further issue. The range of drivers that are considered differ enormously in these studies. The DTI study includes both e-commerce and e-business technologies and asked respondents to list all those factors that influenced adoption. In this way some 23 key drivers were identified. More commonly, the researcher specifies the set of likely factors and respondents are asked to rank their importance. This has the advantage of clarifying responses and ensuring consistency of meaning. On the other hand, it may produce a less exhaustive picture. For instance, Daniel and Grimshaw (2002) tested 7 possible drivers, organised into 4 categories (competitors, customers, internal operations, and suppliers) in their comparative study of large firms and SMEs. Quayle (2002), on the other hand, reports findings based on the highest number of respondents agreeing with particular statements. Consequently, it is unclear how many drivers were actually tested in the study.

In addition to the drivers identified in empirical studies of e-commerce adoption, one should consider factors that have been identified in studies of older generations of ICTs. Two factors have been highlighted in the information systems literature: that

new ICTs are a logical extension of previous ICTs, and that new ICTs can facilitate the integration of previously separate information systems. Both improve the quality of support to managerial decision-making (Galliers, 1991; Earl, 1996). Field work conducted by the authors has prompted two further factors. First, pressure from an allied company may be an important external driver. A number of smaller SMEs stated they had been pressurised by larger allied firms into adopting internet-based technology. Second, adoption may be driven by expected improvements in company image. Field work again suggests that a number of SMEs may have adopted internet-based ICTs in order to improve their image rather than for organisational or strategic motives. Again, we wished to test if this could be a statistically significant factor in a large sample of SMEs.

In total, there are 10 potential internal/external business drivers to be tested: competitor pressure in the industry, customer pressure on the firm, pressure from key suppliers, pressure from allied companies, the perceived importance of e-business by managers, the expansion of national market share, the expansion of global market share, improving company image, a logical progression of past investments, the integration of IT operations. Each of these factors represents a separate testable research hypothesis (Hypotheses 1-10).

2.2 Role of the CEO/owner

A common proposition, found across a range of literatures, is that successful ICT adoption by SMEs requires the active participation of the CEO/owner in IT investment (e.g. Raymond and Magnenat-Thalmann, 1982; Steinhoff and Burgess, 1986). A strong parallel exists here with large business studies that highlight the importance of top management support (e.g. Cerveny and Sanders, 1986; Earl, 1996; Daft, 1998). The need for CEO/owner involvement in ICT decision-making is underpinned a characterisation of SMEs as businesses with flat organisational hierarchies in which the CEO/owner takes the majority of long-term planning decisions, and has full control of the organisation's financial and human resources. As a consequence, CEO support is essential for establishing appropriate ICT goals, identifying critical business information needs, allocating the requisite financial resources, and managing the implementation phase.

Empirical studies by Igbaria *et al*. (1998) and Premkumar and Roberts (1999) found CEOs took a key role in driving the adoption of internet technologies, and the subsequent development of e-business solutions. Meanwhile, research conducted by Palvia and Palvia (1999) found a significant association between IT satisfaction and the age and experience of the CEO/owner. It is important to note, however, that the Igbaria *et al*. sample only contains firms with 20 to 100 employees. The majority of firms in the Premkumar and Roberts' sample have less than 5 employees (the largest firm having just 36 employees), while the Palvia and Palvia study has a median firm size of just 4 employees! It comes as no surprise, then, that the owner is found to be the primary IT user, or that the owner's personal characteristics correlate closely with recorded satisfaction levels. But does the characterisation hold across all SMEs? This prompts the following research hypothesis,

Hypothesis 11: Adoption depends on the CEO/owner being the IT decision-taker.

2.3 Absorptive capacity

Competence based theorists frequently suggest that firms' abilities to acquire, assimilate and exploit new technological knowledge (their 'absorptive capacity') is directly related to their portfolio of human resources (Cohen and Levinthal, 1990; Arora and Gambardella, 1994; Szulanski, 1996). Indeed, studies of ICT adoption frequently highlight in-house technical capabilities and experience with other ICTs as key contributory factors (e.g. Raymond, 1985; Yap *et al*., 1992; Chapman *et al*., 2000). In addition, the importance of managerial capabilities has been highlighted (Venkatraman, 1994; Mullins *et al.*, 2001; Tetteh and Burns, 2001). These include the strategic appreciation of new market opportunities, the organisational implications of new ICTs, and the ability to successfully implement ICTs to leverage competitive advantage. Previous research on UK SMEs suggests problems exist in both areas. Chapman *et al*. (2000) and Spectrum/DTI (2001) suggest that UK SMEs tend to lack the in-house technical skills necessary to successfully implement e-business strategies. This despite the wide range of national and EU programmes offering SMEs support for training (Hamill and Gregory, 1997; Lebre La Rovere, 1998; Fariselli *et al*., 1999). Meanwhile, Spectrum/DTI (2001) suggests that UK SMEs are unable to take advantage of the opportunities afforded by e-business ICTs. According to Tetteh and Burns, "few SMEs realise that they need a strategic

appreciation of the dynamic of the Web and that they will have to develop the capabilities for managing the information infrastructure for an e-business" (Tetteh and Burns, 2001, p.171). Empirical research by Yap *et al.* (1992) indicates an association between successful implementation and SMEs' experience of previous ICTs. Raymond (1985) reasoned that problems relating to ICT implementation require time to be resolved and, hence, measured success will be time dependent. In addition, experience gained through the ownership and application of other ICTs are likely to assist firms in identifying and understanding the organisational and strategic issues raised by e-business investments.

Hypothesis 12: Adoption depends on firms' in-house competences.

This will be tested using two types of proxies. First, the education qualifications of company staff. The dataset contains two indicators of formal education and training – the percentage of staff and management that hold a university degree or higher, and the percentage of staff and management that hold a vocational qualification. The second proxy used is the use of other ICTs. Clearly, this is a far weaker indicator of competences. The dataset contains information on the ownership of websites, e-mail, intranets, client extranets, supplier extranets, and TCP/IP-based EDI.

2.4. Size and business activity

Comparative studies of SMEs and large businesses have promulgated a characterisation of SMEs that is now found in numerous literatures. According to this characterisation, SMEs contain flat, flexible hierarchical structures, and are able to arrive at quick and effective decision-making by virtue of the CEO/owner taking multiple roles in the daily running of the business. It is further postulated that SMEs have closer and more direct relationships with their customers, and are more responsive to changes in demand than large organisations. This would suggest, for example, that SMEs are more likely to engage in ICTs that enhance customer services than large firms. This stylised characterisation obscures the tremendous heterogeneity that exists amongst small and medium sized enterprises. The authors have previously voiced their concerns about this characterisation (Windrum and de Berranger, 2003). Put simply, SMEs differ enormously across all conceivable dimensions, not only with respect to employee numbers (10 to 250 employees) and

annual turnover (up to 50 million Euros)[2], but also in their business activities (manufacturing and services), degree of international exposure, customer bases, sector characteristics, technological sophistication[3]. *Ex ante*, one would expect that, in bridging such different internal and external forces, a variety of organisational structures could evolve. Some of these will more closely those of 'large' businesses and some more closely resemble those of 'micro' businesses. Indeed, differences between companies contained within the SME category may be as great as those that are supposed to exist between the 'typical' SMEs and the 'typical' large business organisation.

In this paper, we consider the influence of two of these factors on SME behaviour: company size and business activity. Size is likely to be a significant factor. For example, a smaller sized SMEs (with 10-49 employees) operating from one office and primarily serving a local/regional market, is more likely to have an organisational structure that resembles that of a micro businesses (with 1-9 employees). Here decision-making may indeed reside largely in the hands of an owner-manager who is responsible for all business activities, including IT strategy and procurement. Given a relatively simple organisational structure, and a low volume of information to be communicated and stored, there is a less compelling need for ICTs to manage information. By contrast, a larger sized SME (with 100 to 249 employees) that has a number of different offices within the UK, and perhaps overseas, will have a more complicated organisational structure. Indeed, it is likely to resemble that of a 'large' business (with 250+ employees), comprising a number of distinct departments (such as sales, production, marketing and perhaps even IT), each with its own budget. This leads us to the following research hypothesis,

Hypothesis 13: Adoption depends on the total number of employees in the firm.

Business activity is likely to be another significant factor affecting ICT adoption. Recent literature on services innovation has emphasised an important distinction between the activities and economic performance of 'knowledge intensive services'

[2] EC (2003).

[3] Dixon *et al* (2002) similarly argue the need for integrated studies of SMEs that consider and recognise the diversity of firms' size, business activity, management support and ITC experience.

(KS) and 'non-knowledge intensive services' (NKS) (e.g. Boden and Miles, 2000). The knowledge content of KS businesses (such as architecture and civil engineering, banking and insurance, and IT hardware/software suppliers and consultancy) is far higher than in NKS businesses (such as refuse collection, wholesale and retail traders, and personal services). KS industries are high users of ICTs, and even integral producers of these technologies. This prompts our final research hypothesis,

Hypothesis 14: Adoption depends on the business activity of the firm.

A distinction, commonly made in the past, is that between the adoption and use of ICTs by services and by manufacturing sectors. The dataset contains information on SIC codes, enabling service firms to be clustered into KS and NKS business activities. Appendix 1 provides the categorisation of KS and NKS business activities used in this study. We shall consider whether KS and manufacturing firms[4] are possibly more similar in ICT adoption patterns than thought, or, if they are different, consider why this may be the case. This has not been tested in previous ICT adoption studies, and so is novel to this study.

3. Data and descriptive statistics

The data for the analysis is drawn from the UK SME-Internet Tracking Study. The study was implemented in 2003. The questionnaire is 8 pages long, and was administered by the authors by post. The questionnaire was piloted (pilot sample of 20 firms), and the pilot respondents were provided with a help service to guide them through the questionnaire. The types of questions used in the study are drawn from previous research on ICT adoption (see section 2) and the OECD's Olso Manual on innovation (OECD, 1997). The areas covered by the survey include ownership of various internet-based ICTs, expenditures on ICTs, the organization of ICT decision-making, the effects of ICT adoption on the firm, internal/external factors that stimulate or hamper adoption, and sources of information for ICTs.

The survey was sent to a randomised sample of 1800 manufacturing and service sector firms, drawn from the Dunn and Bradstreet database. The sample was stratified by the Standard Industrial Classification (SIC) classes for all (private

[4] Given the constraint that NKS = KS + manufacturing in our dataset, we can only test for variation between two generic types of business activity.

sector) manufacturing and services. The sample was also stratified by region and by size to reflect the total demographic characteristics of the UK economy. An eight page postal questionnaire was sent to the sample companies in January 2003. 187 completed questionnaires were returned (10.4% response rate). Of these, 164 companies met the SME criteria of independent ownership and employee size (10-250), and could be included in the sample. The responses were voluntary, and respondents were promised confidentiality. One-third of the respondents are located in manufacturing sectors, while two-thirds are located in service sectors. The services firms have been clustered into two groups, knowledge intensive service (KS) sectors and knowledge intensive service (NKS) sectors. The categorisation of KS and NKS sectors used in the study is found in Appendix 1. Within the services category, 58% of respondents (39% of the total sample) are located in KS sectors while 42% (28% of the total sample) are located in NKS sectors. Examining the sample according to company size, just over 40% of respondents have 10-49 employees, with the remaining sample equally divided between companies with 50-99 employees, and 100-249 employees. Descriptive statistics of the means and standard deviations of the variables, together with the simple Pearson correlation coefficients between the variables are provided in Appendix 2.

Some 95% of all respondents own e-mail, while 86% have a company website. Further, 88% of respondents have both e-mail and a company website. The findings suggest that these particular information technologies are now well-established within UK SMEs, and compares very favourably with the findings of studies that have focused on e-mail and website adoption within large UK firms (with 250+ employees). Turning to other IT systems, 40% of respondents have an intranet, while 12% have an extranet. Just 10% of respondents have both an intranet and an extranet. Within the extranet category, 11% are client-facing extranets and 8% are supplier-facing extranets (5% of all respondents have both a client-facing and supplier-facing extranet). Finally, 7% of all respondents own an 'open' internet-based EDI system.

It is not unreasonable to expect a difference between the adoption of more ubiquitous communication technologies such as e-mail and websites, on the one hand, and more specific communication technologies such as intranets, extranets and EDI, on the

other. E-mail and websites are capable of transmitting all types of information, in multiple formats (through attachments and downloadable files), to any number of people. By contrast, intranets, extranets and EDI support specific types of communications between particular people and, most clearly in the case of EDI, only particular types of structured information may be communicated. Having said this, the ownership rates of extranets and EDI are low, suggesting that much scope exists for the profitable acquisition and implementation of these information and communication technologies.

4. Statistical analysis

Since the dependent variable (ownership of an intranet or extranet) is a discrete choice variable, a logit model is applied as the means of estimating the factors that influence the probability of adoption (see Dougherty, 2002).

4.1 Measures

Dependent variables: here we are testing the factors that influence the probability of two different internet-based ICTs: internets and extranets. Hence, two separate models are estimated, one for intranet adoption, and one for extranets adoption. If the firm in question replied that it does not own either an intranet (extranet), then variable takes the value of 0. If firms respond that they do own an intranet (extranet) then the value is 1.

Independent variables: we apply similar independent variables for internal/external business drivers used in previous ICT studies, and whether the CEO/owner is the ICT decision-maker. 10 internal/external business drivers are tested. Of these, 4 are external business drivers: competitor pressure (*COMP*), customer demand (*CUST*), key suppliers (*SUPP*), and allied company (*ALLIED*). 6 internal drivers are tested: the strategic aim to expand national market share (*NATMKT*), to expand global market share (*GLOBMKT*), company image (*IMAGE*), logical progression in ICT development (PROG), integration of business operations (*BUSINT*), and managers' perception of the importance of e-business (*EB_IMP*). Ordinal data on each of these variables was collected using a 5-point Likert scale. Respondents were asked to rank the importance of each driver to their decisions to adopt, where 5 is 'extremely significant influence', and 1 is 'no influence'.

Information gathered on whether the CEO/owner or, alternatively, whether another manager is the ICT decision-maker is gathered in similar way to Raymond and Magnenat-Thalmann (1982) and Steinhoff and Burgess(1986). In the dataset this is translated into a dummy variable (*CEO*) that takes the value of 1 if the CEO/owner is the decision-maker, and the value of 0 otherwise. Absorptive capacity is also tested. Two types of proxies for absorptive capacity are considered here: education levels of staff, and the ownership and application of other internet-based ICTs. The dataset includes two variables on staff education levels. One is the percentage of the firm's staff holding a university degree or higher (*%UNI*), the other is the percentage of staff holding a technical/vocational qualification (*%TECH*). These two variables are mutually exclusive. The dataset includes information on six internet-based ICTs in total: website (*WEB*), e-mail (*EMAIL*), intranet (*INTRANET*), client extranet (*CLIEXT*), supplier extranet (*SUPPEXT*), and TCP/IP-based EDI (*EDI*). Each of these takes the form of a dummy variable. As pointed out in section 2, a number of additional explanatory variables are considered. First, we include data on firm size. In the statistical analysis the number of employees (expressed in logarithms) is used as the measure of firm size (*LOGEMP*). Second, the business activity of the firm is included. For this, dummy variables are set up for each of the three categories of knowledge intensive services (*KS*), non-knowledge intensive services (*NKS*) and manufacturing (*MANUF*), and tests are conducted on *KS* and *MANUF*.

4.2 Statistical Results

Table 2 presents the logit estimation on factors affecting the probability of adopting a company intranet. 8 of the variables tested are found to be statistically significant, 3 at the 1% level and 5 at the 5% level. All estimated coefficients have the expected sign. Of the external business drivers, competitive pressure ($p = .010$) and customer demand ($p = .011$) are statistically significant. Of the internal factors, the strategic objective to increase national market share ($p = .014$), and ICT integration are statistically significant ($p = .008$). The findings suggest that SMEs are aware of intranet adoption within the industry and take this into account in their own decision-making. This lends support to those who suggest bandwagon effects (e.g. 'keeping up with the Joneses') played a role in the ICT boom. However, the findings indicate that intranet investments are not just bandwagon phenomena. Adoption is also

motivated by strategic market objectives. There is not. Intranet investments are a means of improving internal communications, and are viewed as a means of integrating ICTs, thereby enabling firms to become more responsive to customers and, as a consequence, improve domestic market share. Interestingly, global market shares are not statistically significant. This lends support to the proposition that SMEs focus on domestic rather than international markets. Interestingly, suppliers and allied firms are not found to be significant influences on adoption decisions in this sample.

The findings support the hypothesis of a positive relationship between investment and firm size. *LOGEMP* is statistically significant at the 1% level (p = .006). With regards to the business activity of the firm, *KS* is statistically significant at the 1% level (p = .001) and *MANUF* at the 5% level (p = .016). It would appear that business activity *is* a key factor, and that, in this case, manufacturing and KS SMEs are both motivated to invest in intranets. Turning to the decision-making role of the CEO/owner, *CEO* is not statistically significant (p = .164). Thus, there is no support for the hypothesis that adoption depends on the CEO/owner being the IT decision-taker. Similarly, the absorptive capacity hypothesis is not supported by the findings. Neither technical qualifications nor degree/higher university qualifications are statistically significant. Turning to the much weaker proxy of other ICT usage, only one internet-based ICT, client extranet (p = .033), is found to be statistically significant.

Table 3 presents the logit regression estimation on client extranet adoption. 5 of the variables tested are found to be statistically significant, 4 at the 1% level and 1 at the 5% level. With one (particularly notable) exception, the estimated coefficients again have the expected sign. Only one of the estimated internal/external business variables tested is found to be statistically significant. This is the strategic objective to increase national market share (p = .045). Neither customer pressure nor competitor pressure are found to be statistically significant. Initially, this seems rather surprising. However, given that extranet diffusion is slower than intranet adoption, and that far fewer SMEs in the sample have so far invested in extranets, the findings may be in line with Daniel and Wilson's proposition that firms are becoming more proactive and strategy-driven in their ICT investments. In this case,

extranet adoption is proactive and strategic in its objective of improving customer relations and, hence, increasing domestic markets share. It is not, the findings suggest, a response to customer pressure or a reaction to rivals' behaviour. Turning to the other business drivers, global market shares are not statistically significant, nor are pressure from suppliers or allied firms.

Perhaps the most surprising finding concerns the estimated coefficient for *CEO*. This is statistically significant at the 5% level ($p = .050$). However, its sign is not positive but negative! The finding leads us to reject the hypothesis that the adoption depends on the CEO/owner being the IT decision-taker. Indeed, it is clear that the CEO/owner is not the main ICT decision-maker in our sample. Support for the absorptive capacity hypothesis is once again very poor. Neither technical qualifications nor degree/higher university qualifications are found to be significant in the estimated regression for client extranet adoption. Turning to the weaker proxy of other ICT use, two variables are found to be significant: intranet ($p = .030$) and supplier extranet ($p = .007$).

The logit regression adds further support to the hypothesis of a positive relationship between investment and firm size. *LOGEMP* is statistically significant at the 5% level ($p = .036$). Finally, with regards to business activity, the data again indicates business activity is a key factor. This time, however, *KS* is statistically significant at the 5% level ($p = .035$) but *MANUF* is not ($p = .631$). This is an intriguing finding. It further challenges the myth that services firms are technologically backward compared to manufacturing firms. It also supports recent research in services innovation that suggests KS businesses can be more active than manufacturing firms in exploiting those technologies that directly improve the firm-client relationship.

Table 2. Logit regression 1: Factors affecting the probability of adopting a company intranet

Dependent Variable: Intranet, Mode (0= non-ownership, 1=ownership)				
Explanatory Variable	Reference Hypothesis	Estimated Coefficient	Standard Error	*p*-value
COMP	H1	.719	.278	.010
CUST	H2	.637	.249	.011
SUPP	H3	.357	.328	.276
ALLIED	H4	-.495	.301	.100
NATMKT	H5	.690	.280	.014
GLOBMKT	H6	.152	.244	.534
IMAGE	H7	-.293	.307	.341
PROG	H8	-.284	.270	.292
BUSINT	H9	.744	.278	.008
EB_IMP	H10	.184	.300	.540
CEO	H11	-.748	.538	.164
%UNI	H12	-.009	.014	.535
%TECH	H12	-.015	.015	.314
WEB	H12	-8.741	22.353	.696
EMAIL	H12	5.113	22.264	.818
CLIEXT	H12	2.373	1.114	.033
SUPPEXT	H12	-.235	1.098	.831
EDI	H12	-.933	1.135	.411
LOGEMP	H13	.012	.005	.006
MANUF	H14	.905	.375	.016
KS	H14	3.015	.883	.001
MODEL STATISTICS				
N		140		
Nagelkerke R Square		.603		
Model Chi-square	(21df)	84.181		000
Classification Rate		82.9%		
-2 Log likelihood		109.900		
Hosmer and Lemeshow Chi-square Test	(8 df)	3.194		.922
Total # steps	10			

Table 3. Logit regression 2: Factors affecting the probability of adopting a client extranet

Dependent Variable: Client Extranet, Mode (0= non-ownership, 1=ownership)				
Explanatory Variables	Reference Hypothesis	Estimated Coefficients	Standard Errors	*p*-value
COMP	H1	2.531	1.437	.078
CUST	H2	.259	.644	.687
SUPP	H3	.601	.588	.306
ALLIED	H4	-.258	.734	.725
NATMKT	H5	1.866	.929	.045
GLOBMKT	H6	-.651	.536	.224
IMAGE	H7	-.077	.721	.915
PROG	H8	-.569	.720	.429
BUSINT	H9	-.792	.640	.216
EB_IMP	H10	.099	.688	.885
CEO	H11	-3.779	1.925	.050
%UNI	H12	-.007	.026	.779
%TECH	H12	-.008	.043	.858
WEB	H12	-28.329	164.559	.863
EMAIL	H12	-4.992	164.366	.976
INTRANET	H12	4.436	2.040	.030
SUPPEXT	H12	6.952	2.586	.007
EDI	H12	3.913	2.086	.061
LOGEMP	H13	2.593	1.239	.036
MANUF	H14	.672	1.397	.631
KS	H14	7.928	3.767	.035
MODEL STATISTICS				
N		140		
Nagelkerke R Square		.907		
Model Chi-square	(21df)	159.680		000
Classification Rate		95.0%		
-2 Log likelihood		34.402		
Hosmer and Lemeshow Chi-square Test	(8 df)	9.308		.317
Total # steps	9			

5. Conclusions

The first step taken in this paper was to identify a set of potential factors that can influence the adoption of e-business ICTs by SMEs. Given the current dearth of published research, this was not a trivial task. By examining research on the adoption of older generations of ICTs, drawn from a number of different literatures, a set of potential internal and external business drivers was identified. In addition, the role of the CEO/owner in ICT adoption, and firms' absorptive capacity were identified as potentially important factors. Further, previous case study research

conducted by the authors suggested two further factors: firm size and business sector within the SME category. Both are novel to discussions of ICT adoption behaviour by SMEs.

The hypotheses were tested by running logit regressions for intranet and client extranet adoption on a dataset of 164 UK SMEs. These have generated a number of intriguing findings. To start with, the findings on business drivers are, generally speaking, consistent with earlier empirical studies of e-commerce adoption in that customers and competitors are highlighted once again. Having said this, there are noticeable differences between the intranet and extranet regressions. These findings appear to suggest that, thus far in the diffusion cycle, extranet adoption has been more proactive and strategically orientated than intranet adoption. Direct competitor pressure and customer pressure are highlighted in the intranet regression but are absent in the extranet regression, while the strategic objective to improve national market share was the only internal business driver found to be significant for extranet adoption. Improving national market share was also identified as a key factor for intranet adoption, as were ICT integration. Thus, while intranet adoption appears to be have been more reactive to external pressures by customers and competitors, it was not simply motivated by 'keeping up with the Joneses' behaviour. The findings indicate that intranet adopters also had clear strategic objectives in mind. It is also interesting to observe that pressure from suppliers and allied firms were not found to be statistically significant, either for intranet or extranet adoption, in our sample. Equally interesting is the finding that strategic objectives to improve national market shares were found to be statistically significant in the sample, improve global market shares were not. This is in keeping with research conducted elsewhere that suggests SMEs tend to be far more orientated towards domestic markets, and less towards international markets, than large business organisations.

Running an e-business system is likely to require particular competences. The problem is that researchers are divided over where these reside - individual employees, teams, organisation structures, or organisation cultures? Two proxies were used in our tests. First, individual human capital, proxied by the percentage of employees with vocational qualifications, and university or higher degrees. Second, in-house experience of using ICTs, proxied by the co-presence of other internet-

based ICTs. The human capital proxies are not found to be statistically significant in either regression. Client extranets are found to be statistically significant for intranet adoption, while intranets and supplier extranets are statistically significant for extranet adoption. The weakness of these findings, and the indirectness of these variables as proxies of absorptive capacity are such that the hypothesis is neither clearly supported nor disproved. Clearly, there is a need to identifying more appropriate proxy variables in future research.

One of the most striking findings of this study is the rejection of the CEO/owner hypothesis. Much has been made by authors such as Igbaria *et al.* (1998), and Premkumar and Roberts (1999) of the importance of the CEO/owner's direct involvement in ICT decision-making. However, the findings reported here clearly reject this hypothesis. Not only is the relationship found to be statistically insignificant for intranet adoption but, worse for the proponents of the hypothesis, a negative and statistically significant relationship is estimated for extranet adoption. Why should our findings differ so noticeably from studies such as Igbaria *et al.* (1998), and Premkumar and Roberts (1999)? These studies are based on samples that are highly problematic, both in terms of total size of sample, and in the types of SMEs included. The Igbaria *et al.* sample only contains firms with 20 to 100 employees, while the majority of firms in the Premkumar and Roberts' sample are micro businesses and not actually SMEs. Within such highly restricted samples there is a high probability of that CEO/owners happen to be the ICT decision-maker. This is nothing more than a statistical artefact. It does not indicate that adoption depends on CEO/owners being the ICT decision-maker. In order to support such a hypothesis, one must examine a sufficiently large sample that includes the full range of SME firms, i.e. 10 to 250 employees. The sample used in our study meets both of these criteria.

In order to appreciate why there is no reason to expect a positive correlation between adoption and the CEO/owners being the ICT decision-maker – and, indeed, why a negative correlation may exist – we need to appreciate the extent to which the hypothesis is rooted in the characterisation of SMEs as firms with flat organisational structures in which the CEO/owner performs multiple roles in the daily running of the business. In addition, the CEO/owner is assumed to control the long-term

planning and resources of the firm. In such an organisational set-up, CEO support would clearly be essential for establishing appropriate ICT goals, identifying critical business information needs, allocating the requisite financial resources, and managing IT implementation.

The findings indicate that the characterisation of SMEs simply does not hold. To begin with, size is found to be a key factor in both the adoption of intranets and extranets. At this early stage of the diffusion cycle, larger sized SMEs are more likely to invest in intranets and extranets than smaller sized SMEs. Further, as the size of firm increases, so it is more likely that the ICT decision-maker is not the CEO/owner but a specialist middle manager, often in control of an independent departmental budget. In other words, the organisational structures of larger SMEs are more akin to the specialised, divisional hierarchies that are traditionally associated with large business enterprises. This explains why a statistically insignificant result is estimated for intranets (which have diffused more readily across the population of SMEs), and why a negative correlation is estimated for extranet adoption (which diffused less to smaller and middle sized SMEs).

Opening up the SME 'black box' has highlighted an equally important distinction; that investment in new ICTs also differs between business activities. Indeed, the findings support those who have challenged the 'services myth' that states service firms are, *de facto*, technologically backward compared to manufacturing firms. In distinguishing KS from NKS firms, we find that both manufacturing and KS SMEs are key adopters of intranet technology. Even more strikingly, it is the KS SMEs in our sample who are championing new extranet technologies, not manufacturing SMEs. This accords with research in services innovation. KS firms have greater direct interaction with their clients in the specification, design and production of their final products than manufacturing firms, and so are more disposed to championing innovations, such as client extranets, that further enhance this interaction.

To summarise, the findings of this research have important implications for future research in this area. First, and foremost, the high degree of heterogeneity across SMEs needs to be appreciated and taken into account in future empirical and theoretical research. The variety of organisational structures and the business activities of firms are key factors affecting new ICT adoption. Future empirical

studies need to explicitly take the distinction between KS and NKS into account. Not only can KS firms be as important as manufacturing firms in championing new technologies, they may actually be proactive in championing certain types of new technology, such as client extranets. Variation in firm size and organisational structures are also key factors. Larger SMEs have more complicated organisational structures and communicate and store far larger volumes of information than smaller sized SMEs. Consequently, they have a greater incentive to adopt new e-business ICTs. It is therefore important to move away from the myth of the CEO/owner as the key adoption factor. CEO/owner support may be important, but it is most unlikely to be sufficient in large organisations. Instead, consensus among, and the active support of, top managers are important, as it is in large business organisations. Finally, the research has further highlighted the need for improved measures of absorptive capacity. Despite the widespread support of the absorptive capacity theory amongst many theorists, its detection in statistical studies continues to raise a question mark. There remains much to do in terms of identifying a clear set of instruments with which to test the theory.

Appendix 1. Categorisation of KS and NKS sectors in the study

Knowledge intensive sectors (KS) categorisation	
Architecture, surveying, civil engineering and other construction services	Media – film, video, television and radio production/broadcasting, journalism, press and news agencies
Banking, insurance and other financial services	Post and telecommunication companies including courier services
Business services – legal, accounting, auditing, market research, public opinion, business and management consultant	Recruitment agencies
Education and training services	R&D consultancy services, technical testing and analysis
Hardware/software consultancy and supply, data processing, IT consultancy	Transport, storage including travel agencies
Marketing and advertising services	

Non-knowledge intensive sectors (NKS) categorisation	
Construction – site preparation, building installation, and completion	Recreational and leisure facilities - museums, sports halls, theatres etc.
Health and social work	Refuse collection and disposal
Hotel and restaurants	Wholesale and retail trade, including repair services
Private households with employed persons	Other services: cleaning services (inc. industrial cleaning), hairdressing and other beauty treatment, funeral and related activities
Real estate, renting	

Appendix 2. Descriptive statistics: Means, standard deviations and correlations amongst sample variables

Variable	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1 NKS	.30	.46	1																						
2 KS	.31	.46	-.432**	1																					
3 Manuf.	.79	.98	-.529**	-.537**	1																				
4 Employees	3.94	.83	.189*	.004	-.180*	1																			
5 Degree	14.23	22.17	-.236**	.567**	-.310**	.024	1																		
6 Technical Qualification	18.49	20.86	.007	.062	-.064	-.163*	-.013	1																	
7 Website	.86	.35	-.158*	.115	.040	.155*	.113	.048	1																
8 E-mail	.95	.22	-.100	.088	.010	.000	.132	.157*	.479**	1															
9 Intranet	.40	.49	-.291**	.321**	-.029	.175*	.261*	-.043	.296**	.186*	1														
10 Client Extranet	.11	.31	-.144	.318*	-.165*	.165*	.360**	-.007	.142	.080	.348**	1													
11 Supplier intranet	.08	.27	.006	.002	-.007	-.027	.108	.033	.054	.066	.127	.402**	1												
12 EDI	.07	.25	-.122	-.019	.132	.045	.082	-.080	.108	.061	.128	.218**	.192*	1											
13 CEO	.47	.04	.028	.107	.129	-.218**	-.070	-.009	.039	.127	-.161	-.026	-.122	.059	1										
14 Competitor pressure	3.19	.09	-.148	.071	.066	-.066	.147	.182*	.a	.062	.057	.202*	.176*	.069	-.081	1									
15 Customer demand	3.15	.10	-.049	.117	-.067	.064	.170*	.207*	.a	-.061	.208*	.185*	.112	.075	-.122	.415*	1								
16 Key suppliers	2.06	.09	-.129	-.009	.126	-.132	.034	.078	.a	-.079	.145	.105	.210*	.167*	-.116	.263**	.218**	1							
17 National market	3.38	.11	-.119	.094	.018	-.197*	.188*	.165	.a	-.042	.292**	.192*	.173*	.061	-.025	.255**	.207**	.079	1						
18 Global market	2.61	.12	-.234**	-.110	.317**	-.088	.054	.108	.a	-.085	.200*	.031	.049	.236**	.013	.174*	.201*	.113	.498**	1					
19 Company image	3.78	.08	.006	.114	-.114	-.066	.195*	.159	.a	-.020	-.026	.022	.017	-.044	.022	.216**	.124	.065	.245**	.185*	1				
20 Logical progression	2.96	.11	-.085	.202**	-.116	-.128	.287**	.126	.a	-.070	.106	.113	.131	.136	-.050	.220**	.321**	.216*	.283**	.157	.360**	1			
21 Integration	2.45	.10	-.079	.155	-.077	-.014	.167*	.062	.a	-.108	.339**	-.001	.097	.132	-.181*	.042	.146	.320**	.338**	.294**	.079	.417**	1		
22 E-business importance	3.36	.09	.050	-.024	-.022	-.234**	.031	.118	.a	-.052	.102	.111	.186*	.076	.107	.020	.191*	.202*	.347**	.221**	.195*	.342**	.252**	1	
23 Allied company	1.49	.08	-.061	-.008	.063	-.063	-.053	.241**	.a	-.225**	-.042	-.018	.057	-.067	-.131	.195*	.119	.224**	.091	.098	.033	.142	.248**	.187*	1

* p< 0.05, ** p< 0.01
.a Cannot be computed because at least one of the variables is constant

References

Arora, A. and Gambardella, A., 1994, The Changing Technology of Technological Change: General and Abstract Knowledge and the Division of Innovative Labour, *Research Policy*, 23, pp.523-532.

Cerveny, R.P. and Sanders, G.L., 1986, Implementation and structural variables, *Information Management*, 11, pp.91-198.

Chapman, P., James-Moore, M., Szczygiel, M. and Thompson D., 2000, Building internet capabilities in SMEs, *Logistics Information Management*, 13(6), pp. 353-360

Cohen, W.M. and Levinthal, D.A., 1990, Absorptive Capacity: A New Perspective on Learning and Innovation, *Administrative Science Quarterly*, 35, pp.128-152.

Daft, R.L., 1998, *Organization Theory and Design*, 6th ed., New York: West Publishing Co.

Daniel, E. M. and Grimshaw, D.J. (2002), An exploratory comparison of electronic commerce adoption in large and small enterprises, *Journal of Information Technology*, 17, pp.133-147

Daniel, E. and Wilson, H. (2002), Adoption intentions and benefits realised: a study of e-commerce in UK SMEs, *Journal of Small Business and Enterprise Development*, 9(4), pp.331-348.

Dixon, T., Thomson, B., and McAllister, P., 2002, The Value of ICT for SMEs in the UK: A Critical Review, *Report for the Small Business Service Research Programme.* Available at <http://www.sbs.gov.uk/content/research/>, March 26, 2003.

DTI, 2002, Business in the Information Age: International Benchmarking Study 2002, Report.

Dougherty, C., 2002, *Introduction to Econometrics*, Oxford: Oxford University Press.

Earl, M.J., 1996, *Management Strategies for Information Technology*, New York: Prentice-Hall.

EC, 2003, *Commission Recommendation of 6 May 2003 Concerning the Definition of Micro, Small and Medium-Sized Enterprises*, C(2003)1422, Brussels: Commission of the European Communities.

Galliers, R.D., 1991, Strategic information systems planning: myths, reality and guidelines for successful implementation, *European Journal of Information Systems*, 1(1), pp.55-64.

Igbaria, M., Zinatelli, N. and Cavaye, A., 1998, Analysis of information technology success in small firms in New Zealand, *International Journal of Information Management*, 18, pp. 103-119.

Martin, L. M., 2001, E-commerce and existing small firms: a Wets Midlands pilot study of SME Internet use, *Second International European Trade Study Group Conference, Glasgow, September.*

Mullins, R., Duan, Yanqing, and Hamblin, D., 2001, A pan-European survey leading to the developement of WITS, *Internet Research: Electronic Networking Applications and Policy*, 11(4), pp. 333-340.

OECD, 1997, *Proposed guidelines for collecting and interpreting technological innovation data: the 'Oslo Manual'*, Paris: Organisation for Economic Development and Co-operation.

Palvia, P. and Palvia, S., 1999, An examination of the IT satisfaction of small business users, *Information and Management*, 35, pp. 127-137.

Premkumar, G. and Roberts, M., 1999, Adoption of new information technologies in rural small businesses', *Omega, International Journal of Management Science*, 27, pp. 467-484.

Quayle, M, 2002, E-commerce: the challenge for UK SMEs in the twenty-first century, International Journal of Operations & Production Management, 22 (9-10): pp. 1148-1161

Raymond, L., 1985, Organisational characteristics and MIS success in the context of small businesses, *Management Information Systems Quarterly*, 9 (1), pp. 37-52.

Raymond, L., and Magnenat-Thalmann, N., 1982, Information systems in small business: are they used in managerial decisions?, *American Journal of Small Business*, 6 (4), pp. 20-23.

Spectrum/ DTI, 2001, *Business in the Information Age: International Benchmarking Study*, available at <http://www.ukonlineforbusiness.gov.uk/>.

Steinhoff, D., and Burgess, J.F., 1986, *Small Business Management Fundamentals*, 4th Ed., New York: McGraw-Hill.

Szulanski, G., 1996, Exploring Internal Stickiness: Impediments to the Transfer of Best Practice within the Firm, *Strategic Management Journal*, 17, pp.27-43

Tetteh, E. and Burns, J. 2001, Global strategies for SME-business: applying the SMALL framework, *Logistics Management Information*, 14(1/2), pp. 171-180.

Venkatraman, N., 1994, IT-enabled business transformation: from automation to business scope redefinition, *Sloan Management Review*, 35(2), pp.73-87.

Windrum, P, and de Berranger, P., 2003, The Adoption of E-Business Technology by SMEs, in *Competitive Advantage in SMEs*, Jones, O. and Tilley, F. (Eds.), John Wiley & Sons: Cheltenham, pp.177-201.

Windrum, P, de Berranger, P. and Meldrum, M., 2003, SME-Internet Tracking Study Report, Manchester: Manchester Metropolitan University Business School. Available at <http://www.business.mmu.ac.uk/research/reports>.

Yap, C.S., Soh, C.P.P., and Raman, K.S., 1992, Information systems success factors in small businesses, *Omega, International Journal of Management Science*, 20(5), pp. 597-609.